IN THE SPECIFICATION:

Please amend paragraphs [001] - [003], [006], [012], [021], [022], [029], [039], [043], [048], and [110] of the specification as shown below, in which deleted terms are shown with strikethrough and/or double brackets, and added terms are shown with underscoring. Also, after paragraph [132] please add paragraph [133] as shown below.

Paragraph [001]

1.      Field of the Invention

The present invention relates to a technique which provides measurement of the position of an object from an image captured by a camera unit.

Paragraph [002]

2.      Discussion of Background Art

Three-dimensional measurement with images has recently been prevailing as a result of development of processing for the image of a CCD camera or a computer. There are examples such as a technique which measures the position of an object with plural cameras, and [[the]] another one which uses a combination of a camera and a floodlight. The former calculates a distance from the camera to the object with triangulation incorporating a position of each camera and a pixel representative of the object in an image captured by each camera. On the other hand, the latter calculates it with triangulation based on a relative position between the camera and floodlight, and a position of a beam of collimated light in an image captured by the camera. [[The]] Japanese Published Patent Application 9-287927 reports related arts associated with the latter technique. In this connection, these techniques are based on the assumption that a lens system of the camera can be modeled by a pin-hole camera. As shown in FIG.1, a model of pin-hole camera is characterized in that only a beam of light coming through a pin-hole H reaches a plane of image, so that a three-dimensional space (x, y, z) is translated into a two-dimensional space (u, v). The model is thus generated on condition that the incident beam of light passes through the pin-hole, focusing an image in the camera.

Paragraph [003]

However, it is known that the image captured by the camera with the lens system has intrinsic non-linear distortion, and the further it departs from the center, the larger the distortion will be. In this way, it is not possible to measure the accurate position of an object from the image having this type of distortion. A technique for improving the accuracy with compensation for the captured image has been proposed. [[The]] Japanese Published Patent Application 5-274426 reports related arts.

Paragraph [006]

The present invention is directed to overcoming of the problem above described. It seeks to provide a position measurement method, which fundamentally compensates the distortion of an image captured by a camera unit with a lens system and measures the accurate position of an object accordingly, as well as an apparatus, a computer program and a method for generating calibration information to be used for the position measurement method and the apparatus.

Paragraph [012]

The apparatus described above has the image input means which incorporates the image of the object taken by the camera unit and the pixel position detection means which detects the position of the pixel representative of the object. The apparatus also has the position calculation means which calculates the position of the object according to the direction and the displacement of the incident beam of light that are derived from the calibration information.

Paragraph [021]

According to a yet further aspect of the present invention, a computer program for a computer used for an apparatus is provided, which generates calibration information correlating a position of a measurement pixel of an image captured by a camera unit with a direction of an incident beam of light and a displacement from a reference point to the incident beam of light, and measures a position of an object according to an image of the object captured by the camera unit and the calibration information. The computer program is executed by executes the computer in a process

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comprising: (a) incorporating the image of the object, (b) detecting a position of a pixel representative of the object in the image incorporated at process (a), and (c) calculating the position of the object according to the direction and the displacement of the incident beam of light, which are derived from the calibration information with reference to the position of the pixel detected at process (b).

Paragraph [022]

The computer program described above is executed by ~~executes~~ the computer so that the image input means can incorporate the image captured by the camera unit and the pixel position detection means can detect the position of the pixel representative of the object in the image. In this way, the position calculation means can obtain the direction and the displacement of the incident beam of light according to the position of the pixel and the calibration information, thereby calculating the position of the object.

Paragraph [029]

In the method, a step for determining an incident beam of light is repeated according to the number of measurement pixels, and the displacement from the reference point to the incident beam is calculated. In this way, the calibration data is generated, which correlates the direction and displacement of the incident beam of light with the position of each measurement pixel. This leads to quantification of the characteristics of the camera unit.

Paragraph [039]

FIG.10 is a block diagram illustrating the structure of a position measurement apparatus according to an embodiment of the present invention.

Paragraph [043]

FIG.14 is a block diagram illustrating the structure of a position measurement apparatus according to another embodiment of the present invention.

Paragraph [048]

## DESCRIPTION OF THE ~~PREFERRED~~ PRESENT EMBODIMENTS

Embodiments of the present invention are now described in detail. First, description is given to characteristics of a camera which intrinsically conflict with an idealized assumption of pin-hole camera that incident beams of light cross at a point. This leads to one of <u>the</u> causes for distortion of an image captured by the camera with a lens system. Subsequently, description is given to calibration information (calibration table) of quantified characteristics of the camera, and to a method for generating the calibration information by conducting measurement for individual pixels captured by the camera. And description is given to an apparatus for detecting a position of an object, which can remove distortion of the image.

Paragraph [110]

A[[n]] position measurement apparatus 200 shown in FIG.14, which has a camera unit C capturing an image of a collimated beam of light that originates from a laser unit 250 and impinges on an object OB, can determine a three-dimensional position of the object OB according to the image. The apparatus 200 swings the direction of beam of light upward-downward and right-left so that the position of object OB can be determined according to three-dimensional measurement conducted at a large number of points.

Paragraph [133]

<u>Although there have been described what are the present embodiments of the invention, it will be understood by persons skilled in the art that variations and modifications may be made thereto without departing from the spirit and essence of the invention whose scope is indicated by the appended claims.</u>